XIII.

NOTES ON SOME SPECIES OF GYMNOSPORANGIUM AND CHRYSOMYXA OF THE UNITED STATES.

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In a paper published in the Anniversary Memoirs of the Boston Society of Natural History in 1880, I gave an account of my attempts to show, by means of cultures, the relationship of the *Gymnosporangia* found near Boston to the different forms of *Rœstelia* occurring in the same region; and also, by reviewing the geographical distribution of the species of both genera in the United States, to ascertain the probabilities of the genetic connection of different forms of the genera in question. My cultures, however, were not successful in proving the direct relationship of any given *Gymnosporangium* with any given *Rœstelia;* but, as the subject is of importance, both from a biological and practical standpoint, I have made further attempts to see whether a more definite result could be reached.

The method of culture employed was the following. Specimens of different species of *Gymnosporangium* were gathered early in May, before the spores had begun to germinate, and while the spore masses were flat and not swollen in gelatinous protuberances, as is the case when they are moistened by showers. The specimens were then placed in watch-glasses under moistened glasses, each species by itself, when the spore masses soon expanded, and the spores began to germinate. It was in this way easy to arrange so that the spores of the different species were kept pure, — a fact confirmed by microscopic examination. As the spores germinated, the sporidia, of a bright orange color, dropped into the moist watch-glasses, and were used at once for infecting the desired plants. Two kinds of material were used. The first consisted of leaves of different *Pomaceæ*, which were freshly gathered in the Botanic Garden of Cambridge, and at a distance from any species of *Juniperus* which could have been infested by a *Gymnosporangium*. The leaves were placed on moistened glass

slides and arranged on zinc stands under bell-glasses. The sporidia were then carefully dropped upon the leaves, which were immediately covered by a bell-glass. The leaves under each glass were sown with the sporidia of but one species, and subsequently, when it was necessary to remoisten the slides, the bell-glasses were removed for a moment only, and at no time were the leaves under more than one bell-glass exposed. I also used a number of small seedlings of *Pomaceæ*, each pot being covered by a glass receiver. The seedlings were supposed to be in a healthy condition, but, to serve as a check, a number of similar seedlings were kept on which no sporidia were sown. The young plants were inoculated, either by dropping the sporidia upon them, or, in cases where the leaves were not in such a position as to retain drops well, small pieces of the gelatinous spore-masses were placed on them, it first being ascertained that the spores had begun to germinate. After three or four days it was necessary to remove the remains of the gelatinous masses in order to prevent moulding. After the lapse of a week, at which period the germinal tubes, if ever, must have made their way into the leaves, I attempted in a few cases to remove the glass receivers and continue the cultures in the open air. This, however, was impossible, for the plants wilted to such an extent that I was obliged to keep them constantly covered. European experimenters usually expose their cultures to the air after a few days, but it is doubtful whether this can be done in our climate except in the most favorable cases, so great and sudden are the changes of moisture and temperature.

The following statement shows the results of the cultures made in May and June, 1883. I was unable to continue my cultures, unfortunately, in the spring of 1884, as I had intended. The names of the species with which experiments were made are those given in my paper above mentioned, in which the synonymy is given.

I. GYM. FUSCUM *var.* GLOBOSUM.

May 18. Sporidia sown on
5 seedlings of apple.
3 leaves of *Cratægus oxyacantha.*
3 leaves of apple.
4 leaves of *Amelanchier Canadensis.*

May 26. Spermogonia appeared on four of the apple seedlings.

May 28. Spermogonia appeared on the remaining apple seedling, and very abundantly on the three leaves of *Cratægus.*

June 1. Spermogonia appeared on one leaf of apple.

June 8. The spermogonia on leaves named still visible, but the leaves had become so mouldy that there was no hope of the development of æcidia, and the cultures were abandoned.

II. Gym. macropus.

May 18. Sporidia sown on
5 seedlings of apple.
4 leaves of apple.
3 leaves of *Amelanchier Canadensis.*
3 leaves of *Cratægus oxyacantha.*

May 28. Soon after the sowing, the leaves of apple seedlings became mottled, but no spermogonia were plainly seen until the 28th, when they appeared on all the five seedlings.

June 8. Culture abandoned, as the leaves were all mouldy.

III. Gym. clavipes.

May 18. Sporidia sown on
5 seedlings of apple.
4 leaves of apple.
4 leaves of *Amelanchier Canadensis.*
3 leaves of *Cratægus oxyacantha.*

May 23. Spermogonia appeared on one leaf of *Amelanchier.*

May 24. Spermogonia appeared on one seedling apple.

May 26. Spermogonia on two more apple seedlings.

May 28. Spermogonia on two more leaves of *Amelanchier.*

June 10. Leaves mouldy and culture abandoned.

IV. Gym. biseptatum.

May 19. Sporidia sown on
5 seedlings of apple.
3 leaves of apple.
4 leaves of *Amelanchier Canadensis.*
3 leaves of *Cratægus oxycantha.*

May 28. Spermogonia appeared on three *Amelanchier* leaves.

June 5. Leaves mouldy and culture abandoned.

V. Gym. Ellisii.

May 23. Sporidia sown on two seedlings of apple.

May 29. As the previous sowing produced no result, owing possibly to the sporidia not being sufficiently abundant, five seedlings of apple, including the two mentioned above, were sown with fresh material. No result.

Comments on Cultures I.–V. — The cultures I.–III. were started on the same day. No. IV. was not started until the following day, as a microscopic examination showed that the spores were not germinating freely until May 19th. In No. V. the sporidia were not produced in sufficient quantity for sowing until May 23d, and even then they were scanty, so that fresh specimens were collected, which produced a sufficient quantity of sporidia for sowing on May 29th. At the time when the five cultures were started, the only seedlings of a suitable size which could be procured were those of apple; but as it was easier to obtain pure spores of the species of *Gymnosporangium* on the date named, the cultures were then started, and a second series of cultures were arranged later, when other seedlings could be procured. The spores for the second series were from specimens selected with care, so as to be as pure as possible; but from the later date, and the fact that there had been showers which had swollen the masses of spores, the possibility of the accidental mixture of the spores of one species with those of another could not be guarded against with the same degree of certainty as in the preceding series. It may be remarked that in 1883 the season was backward, and the *Gymnosporangia* did not mature as early as they frequently do. In both series of cultures the control plants remained free from spermogonia. Where the statement is above made, that the cultures were abandoned on a given day, it should be understood that the statement applies only to the leaves under bell-glasses. In the cases where spermogonia appeared on the leaves of seedlings, the cultures were kept for a longer period; but these cases will be referred to again later.

VI. Gym. fuscum *var.* globosum.

May 25. Sporidia sown on
2 seedlings of *Cratægus Douglasii.*
1 seedling of *Pyrus* sp. cult.
May 31. Spermogonia appeared on all the seedlings.

VII. Gym. macropus.

May 25. Sporidia sown on
2 seedlings of *Cratægus Douglasii.*
1 seedling of *Pyrus* cult.
June 5. Spermogonia appeared on one *Cratægus.*

VIII. GYM. CLAVIPES.

May 25. Sporidia sown on
1 seedling of *Cratægus Douglasii.*
1 seedling of *Pyrus* cult.
May 31. Spermogonia appeared on seedling of *Pyrus.*

A third set of experiments consisted in placing fresh shoots of *Amelanchier Canadensis* and *Pyrus arbutifolia* in jars of water, covering them with receivers, and sowing on the leaves the sporidia of *G. macropus*, *G. clavipes*, *G. biseptatum*, and *G. Ellisii*. The cultures were started on May 30th, with the following result. On June 4th, spermogonia appeared on both *Amelanchier* and *Pyrus arbutifolia* sown with the sporidia of *G. macropus* and *G. clavipes*, and on *Amelanchier* sown with *G. biseptatum.*

As the sporidia of *G. biseptatum* and *G. Ellisii* proved more refractory than those of other species, two supplementary cultures were made, as follows: —

GYM. BISEPTATUM.

May 29. Sporidia sown on
5 leaves of *Pyrus arbutifolia.*
3 leaves of *Nesæa verticillata.*
Young shoots of *Nesæa, Amelanchier,* and *Pyrus arbutifolia.*
May 31. Spermogonia appeared on leaves of *Amelanchier* shoot.

GYM. ELLISII.

May 29. Sporidia sown on
5 leaves of *Pyrus arbutifolia.*
3 leaves of *Nesæa verticillata.*
Young shoots of *Pyrus arbutifolia* and *Nesæa.*
No spermogonia.

In these last two cultures I was led to try the leaves of *Pyrus arbutifolia* because the form known as *Rœstelia transformans* had been usually found by me in districts near *Cupressus thyoides*, on which *G. biseptatum* and *G. Ellisii* are parasitic. As I had never succeeded in getting spermogonia from sowings of *G. Ellisii* on *Pomaceæ*, it occurred to me that possibly the æcidial form of that species might be found on a host of some other order, and, in the cedar swamps where *G. Ellisii* is found, *Nesæa* abounds and is not infrequently infested with the

striking *Æcidium Nesæa* Gerard. No spermogonia, however, were developed. At the date when the culture was started the leaves of *Nesæa* were not fully expanded; but they soon opened, and the shoots grew rapidly in the house.

In attempting to draw any conclusion from the statements previously given, we may exclude any consideration of *G. Ellisii*, for neither in 1883 nor in previous years did spermogonia appear in any cultures made with that species. The species used include all the members of the genus *Gymnosporangium* known in the Eastern United States except *G. clavariæforme* DC., of which I could not procure fresh material in season, *G. conicum* DC., and the typical form of *G. fuscum* DC. The last two forms require further study, and it is not certain that the few specimens referred to them should not be placed in other species. The results of the cultures may be summarized as follows: —

Spermogonia appeared after sowing the sporidia of

G. fuscum var. *globosum* on seedling apples, on *Cratægus oxyacantha* (very abundant), on *C. Douglasii*, and on apple leaves under bell-glass. In cultures of previous years, also on *C. tomentosa*.

G. macropus on apple seedlings, on *C. Douglasii*, and on shoots of *Pyrus arbutifolia* and *Amelanchier*. Also in previous cultures on *C. tomentosa* and *Amelanchier*.

G. clavipes on apple seedlings and shoots of *Pyrus arbutifolia* and *Amelanchier*.

G. biseptatum on *Amelanchier* leaves and shoots, and previously on *C. tomentosa*.

From the above it will be seen, not only that the sporidia of different species of *Gymnosporangium* when sown on the same host-species were followed by the appearance of spermogonia, but also that the sporidia of each species was followed by spermogonia when sown on several different host-species. The perplexity is all the greater, because the host-plants as a rule are species which, in nature, are attacked by more than one *Ræstelia*, and in the case of the cultures the species could not, of course, be determined by the spermogonia above. In this connection, a word may be said on the production of æcidia by cultures. In the case of leaves kept on slides under glasses, it is of course out of the question to expect to be able to keep the leaves free from mould long enough for æcidia to develop. For tentative experiments, where one wishes to form some notion as to the probability of the connection between certain forms, they do very well. But it may be asked why

æcidia were not produced on the seedlings on which spermogonia appeared. I did my best to keep the young plants alive, but they were all dead by the end of June. Had it been possible to remove the glasses and expose them to the air, they might have done better; but in exposing them to the air, one should not forget that he is also exposing them to the risk of contact with spores from without. On some of my seedlings the spermogonia were very abundant, and it may be urged that, in such cases, the seedlings were destroyed by the violence of the disease itself before the æcidia could form. The same objection, however, will not apply to the seedlings on which the spermogonia were scanty. Yet the latter died, like the former. The spermogonia appeared well marked on some of the leaves, which after some days dropped off, and were followed by fresh crops of spermogonia on other leaves. In the absence of æcidia, can we infer anything from the spermogonia?

Before trying to answer this question, I must say that I attach very little value to what I have called the third series of cultures, — those in which shoots of *Amelanchier* and *Pyrus arbutifolia* were placed in glasses and the sporidia dropped on the leaves, — for the following reasons. The spores were gathered late in the season, after repeated showers, so that a mixture of the spores of different species could not be avoided with approximate certainty; and, furthermore, the spermogonia were very few in number, did not always develop on the spots where the sporidia were dropped, but on remote parts of the leaves, and, in one case they appeared so soon after the sowing — two days — that it is much more probable that the shoots were already infected with the *Rœstelia* before the sowing, than that the spermogonia came in any way from the growth of the sporidia. I think it well, then, to omit from present consideration the cases where spermogonia appeared on shoots of *Amelanchier* and *Pyrus arbutifolia* in the cultures of 1883.

As in previous cultures, so in those of 1883, spermogonia appeared on more hosts, and in greater abundance, after sowing the sporidia of *G. fuscum* var. *globosum* than in the case of the other species. The poorest result came from *G. biseptatum*, if we except *G. Ellisii*, in which there was no result at all. In cultures previous to 1883, in which leaves and seedlings of *Cratægus tomentosa* were used, spermogonia appeared on that host after sowing *G. macropus*, *G. fuscum* var. *globosum*, and *G. biseptatum*. *G. clavipes* was not sown on *C. tomentosa*, as spore material could not be obtained at the date of the cultures. It may, perhaps, be asked whether the *Cratægus* leaves were

not infected with a *Rœstelia* before the sowings. Considering the abundance of *Rœstelia* on *C. tomentosa* in this region, such is very likely to have been the case, but, as far as I could tell at the time, the leaves were healthy. For the sake of the argument, let us omit the cultures on *C. tomentosa*, arbitrarily assuming that there was previous infection.

We have left the fact that *G. biseptatum* was followed by spermogonia on *Amelanchier Canadensis* only. Our only *Rœstelia* growing on the leaves of *Amelanchier* and not found on other hosts is *R. botryapites*, found only on the eastern coast from New England southward, and this it will be noticed is also the range of *G. biseptatum*.*

Turning to *G. fuscum* var. *globosum*, we find that sowings of its sporidia on apples, and on *Cratægus oxyacantha* and *C. Douglasii*, were followed by spermogonia, especially on *C. oxyacantha*, where they were very abundant. The result of the sowings of this species are, then, compared with other cultures, an abundance of spermogonia on *C. oxyacantha* and an absence of them on *Amelanchier*. Of the *Rœsteliæ* growing near Cambridge, *R. aurantiaca* occurs on species of *Cratægus* and apples; but I have not found it on *Amelanchier*, although according to Peck it occurs on that host in New York. The forms included under *R. lacerata* and *R. penicillata* are common on *Amelanchier* near Cambridge, while *G. globosum* was not followed by spermogonia on that host. The *G. globosum* ranges from Canada to Wisconsin and South Carolina. *Rœstelia aurantiaca* extends from New England to Arkansas, where it was found on a species of *Cratægus* by Prof. F. L. Harvey. The distribution of the *Rœstelia* and that of the *Gymnosporangium* are about the same. The *Rœstelia* bears its æcidia usually on the young fruit and stalks, while the spermogonia are borne on the leaves. Hence, in cultures of leaves unaccompanied by young fruit, even if there really is a connection between *G. globosum* and *R. aurantiaca*, one would naturally expect to get only spermogonia. Remembering that the æcidia of *R. aurantiaca* develop on the berries rather than the leaves, I have tried to obtain the young berries for my cultures; but I have never yet found any berries formed at the time when the *Gymnosporangia* were ripe.

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* In my paper on *Gymnosporangia* this species is also given on *Libocedrus* in California, on the authority of Harkness and Moore. I have never examined Californian specimens which, judging from the host, may belong to a distinct species. *G. speciosum* Peck, nearly related to *G. Ellisii*, occurs on *Juniperus occidentalis* in Colorado.

The sporidia of *G. macropus*, when sown, were followed by spermogonia on apple seedlings, on seedlings of *Cratægus Douglasii*, and on leaves of *Amelanchier*. As distinguished from the last species, where the spermogonia appeared most abundantly on species of *Cratægus*, the present shows the growth of spermogonia on apples and *Amelanchier*, and less abundantly on *Cratægus*. *G. clavipes* was followed by spermogonia on apple seedlings, but not on *Amelanchier*. With what two *Rœsteliæ* the two last-named *Gymnosporangia* might be associated one cannot safely guess. Considering the distribution in nature, one would be inclined to suggest *R. transformans* * as belonging to *G. clavipes*, and some form of *R. lacerata* or *R. penicillata* as belonging to *G. macropus*. But it is well not to encroach upon the boundaries of pure imagination.

Rejecting what I have called my third series of cultures on shoots of *Amelanchier* and *P. arbutifolia*, on the ground that they were conducted under conditions not conducive to accuracy, — which I consider to have been the case, — and assuming that the *Cratægus tomentosa* employed in cultures previous to 1883 was already infected with a *Rœstelia* when the experiments began, — which might or might not have been the case,† — the conclusions to be drawn are, that, —

1. The æcidium of *G. biseptatum* is probably *Rœstelia botryapites*.

2. The æcidium of *G. globosum*, to be kept distinct from *G. fuscum*, is possibly *Rœstelia aurantiaca*.

3. The æcidium of *G. macropus* is to be sought among the *Rœsteliæ* growing especially on apples and *Amelanchier*.

If it be admitted that the *C. tomentosa* was not previously infected, but that the development of spermogonia was the result of the sowings, then it follows that the sporidia of our four species in question may produce spermogonia indiscriminately on one and the same host, or on different hosts, in a way which is not paralleled in nature by the species of *Rœstelia*. There is nothing impossible or illogical in this conclusion; but in accepting it we must bear in mind that we must reject the observations of Oersted, and all who have only succeeded in developing spermogonia without æcidia, but have neverthe-

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* *G. clavipes* has been found by Holway in Iowa, and Trelease doubtfully refers to *R. transformans* a spermogonial form, whose æcidia were not seen, found on *P. arbutifolia* in Wisconsin. There is need of further information as to the western limits of both these forms.

† See my paper on Gymnosporangia, pp. 36, 37.

less drawn definite conclusions with regard to the connection between certain teleutosporic and æcidial forms.

Finally, it may be urged that, in all the cases where spermogonia followed the sowings of sporidia, their development was not a result of the sowings, but proceeded from the mycelium of some *Rœstelia* already in the material used. That this was the case in the shoots of *Amelanchier* and *P. arbutifolia* I think was probably true, and the same may have been true in case of the *C. tomentosa*, although I am not prepared either to admit or deny the fact. Admitting the theory of previous infection, however, how are we to explain the case of the *C. oxyacantha*, on the leaves of which spermogonia abundantly followed the sowing of the sporidia of *G. globosum*, but did not appear after the sowing of other species? I must admit that I am much perplexed to explain the frequency of spermogonia in some cases and their absence in others, and the failure of infected seedlings to develop æcidia, or even to show the least traces of them. I should be the last to claim that my experiments were in any sense conclusive, but, on the contrary, recognize their incompleteness, and in some respects their contradictory character. My cultures are only significant in so far as they show more plainly difficulties to be avoided, and the general direction in which one must work to reach a successful result, if such a result is ever to be reached, in the study of the development of our *Gymnosporangia*.

In Appalachia, Vol. III. pp. 239–243, I gave an account of the *Peridermia* of the White Mountains, and stated that the species which occurs on the dwarf form of *Abies nigra* resembles *P. abietinum* (A. & S.), which has in Europe been associated with *Chrysomyxa Rhododendri* and *C. Ledi* as an æcidial form. At the time of my visit to the White Mountains, in August and September, no species of *Uredineæ* was found either on *Rhododendron Lapponicum* or *Ledum latifolium*. As Mr. Edwin Faxon was about to make a botanical excursion to the White Mountains in June and July of 1884, I asked him to examine the *Rhododendron* and *Ledum* on Mt. Washington, to ascertain whether a *Chrysomyxa* occurred on those hosts early in the season. With his accustomed acuteness, Mr. Faxon succeeded in finding a form on *Ledum*, which appears to have been common in some spots in July, but which rapidly disappeared, as the early specimens had an abundance, and the later but little, of the fungus. I visited the locality at the head of Tuckerman's Ravine, where the fungus

was found by Mr. Faxon in July, but at the time of my visit, the second week in August, not a trace of the fungus was to be found, either on the living or fallen leaves of *Ledum*.

The first specimens received from Mr. Faxon were collected on Mt. Washington in June. On the upper surface of the leaves were small blood-red pustules, which a microscopic examination showed to be undistinguishable from the teleutosporic condition of *Chrysomyxa Ledi* (A. & S.). In July other specimens were received from Mr. Faxon where no teleutospores were found, but there was an abundance of a uredo form which presented two different aspects. On the upper side of the leaves, in dark discolored spots, a small number of sori were grouped, generally more or less circularly. Sections showed orange-colored spores with decidedly roughened epispores surrounded by a rim of densely packed cylindrical filaments composed of several cells, the whole surrounded by the ruptured epidermis in form of a cup. The spores were produced in small numbers in chains, but at maturity became free, and were then globose or broadly elliptic, measuring 24–38 μ by 20–26 μ. This epiphyllous form is certainly the *Uredo ledicola*, Peck, of which, through the kindness of Mr. Peck, I have been able to examine an authentic specimen.

In some sections I also found sori on the under side of the leaves. They could scarcely be detected by the eye, owing to the densely tomentose character of the under side of the leaves; but I afterwards noticed that, when small yellowish spots were seen on the upper surface of the leaves, the sori could be found beneath. In a comparatively small number of cases sori were found on both sides of a leaf, but generally this was not the case. In Mr. Faxon's collections the epiphyllous form was more abundant than the other. The two may be equally abundant in nature; but as the epiphyllous form is much the more striking to the eye, it naturally follows that the epiphyllous form would be found more abundantly in collections. In general, the developments of the epi- and hypo-phyllous forms was the same, but there was a constant difference in the mature forms. The sori of the hypophyllous form, instead of being in the shape of widely-opened cups, scarcely sunk at all below the level of the epidermis, looked more like partially immersed conceptacles with slightly contracted orifices, whose outer portion projected beyond the epidermis. The spores also were distinctly narrower and more acutely elliptical, measuring 24–31 μ by 12–19 μ, and the epispore was less rough.

I think that there can be no doubt that the hypophyllous form is the uredo of *Chrys. Ledi*, as it answers closely to the descriptions of

De Bary * and Schroeter,† and to European specimens which I have examined. In Europe it is said to occur only on the under side of the leaves, although Schroeter mentions its occurrence on petioles and young stems of *L. palustre*. Mr. Faxon's specimens consisted of leaves of *L. latifolium* without stems. Schroeter states that he has seen a small specimen from Labrador on *L. latifolium* which was the same as the form on *L. palustre*, but no mention is made of epiphyllous sori. The fungus is also said by Rostrup ‡ to have been found on *L. palustre* in Greenland. Whether our epiphyllous form should be considered distinct from the hypophyllous, must, for the present, remain uncertain. I found the differences stated above constant in all the specimens I examined, and they were not few in number. It may be that the two forms are modifications of the same species depending on the different structure of the upper and under side of the leaves, but the differences are certainly greater than those of many forms which are regarded as distinct by good mycologists. It is, in all events, interesting to know that we have in the White Mountains both the uredo and teleutosporic forms of *Chrys. Ledi* growing in close proximity to *Abies nigra* in regions where it is badly infested with a *Peridermium* which, as stated in my paper already referred to, I am unable to distinguish from *P. abietinum*, one form of which is said by De Bary, in his exhaustive paper on the subject, to be the æcidium of *Chrys. Ledi*. The teleutospores were found only in the first set of leaves collected by Mr. Faxon, it will be remembered, while the uredo was collected later. The finding of the teleutospores before the uredo may, in this case, have been merely accidental, and does not show that the uredo was developed later than the teleutospores. Cases have, however, been cited by De Bary, in which the uredo certainly did not develop until after the teleutospores.

In this connection it should be noticed that a new *Æcidium pseudocolumnare* from the Black Forest has been described by Prof. J. Kuehn, in Hedwigia, November, 1884. The species is said to be characterized by having white spores, and one is inclined to ask whether this may not be the same as *Peridermium balsameum* Peck, of the White Mountains and the Adirondacks, which is distinguished from *Æ. columnare* by having white spores.

Besides our common *Chrysomyxa* on *Pyrola*, a species was found on *Abies Canadensis* at Chebacco Lake, Essex Co., Mass., by Mr.

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* Bot. Zeit., xxxvii. 802.

† Beitr. zur Biol. der Pflanzen, iii. 52.

‡ Revue Mycologique, vi. 210.

A. B. Seymour, in June, 1883. This is probably the same as the *C. Abietis* of Europe, although, as the spores were not quite ripe, one cannot be certain. If there is a difference, it is to be found in the fact that the teleutospores are arranged in threads which branch less than in the European form. But at a later stage of development this supposed difference might disappear. At the same time and place Mr. Seymour found another interesting species of *Uredineæ* also on *Abies Canadensis*, not on the same branches as the species last mentioned, nor on the same trees, as far as can now be ascertained. Spermogonia were abundant on both sides of the leaves, on whose under surface were elliptical or elongated sori of a pale yellow color, arranged in two rows parallel to the midrib.

The spores were globose or somewhat elliptical, about 13–17 μ in length, and appeared to be borne in chains composed of a small number of spores. It is possible that this form is *Cæoma Abietis-pectinatæ* Rees, of which I have seen no specimens. From the description of Rees, however, his species has larger spores than ours, and no mention is made of spermogonia. It may be well to designate our form under the name *Cæoma Abietis-Canadensis*, until more exact information can be obtained. Prof. J. Macoun has found the interesting *Melampsora sparsa* Winter on *Arctostaphylos alpina*, on the island of Anticosti. Visitors to the White Mountains should search for the fungus there.